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TEACHING SCIENCE TO THE DISADVANTAGED PUPIL.

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SCIENCE PROGRAMS FOR THE DISADVANTAGED HIGH SCHOOL STUDENT ARE FREQUENTLY DEFICIENT IN CONTENT, IN FACILITIES AND MATERIALS, AND IN PROPER INSTRUCTION AND TEACHER ATTITUDES. RATHER THAN A REVIEW OF HEALTH, NUTRITION, AND DISEASE, PROGRAMS FOR THE DISADVANTAGED SHOULD TEACH FUNDAMENTAL SCIENTIFIC CONCEPTS BY USING A DISCOVERY APPROACH AND LABORATORY TECHNIQUES. IN 1963, THE BIOLOGICAL SCIENCES CURRICULUM STUDY DEVELOPED THREE EXPERIMENTAL UNITS (GENETICS, ECOLOGY, AND CELLULAR BIOLOGY) FOR TEACHING BIOLOGY TO THE LOWER 30 PERCENT OF STUDENTS IN ACADEMIC CLASSES. THESE UNITS WERE TO BE TESTED ON 1,000 STUDENTS DURING THE 1963-64 SCHOOL YEAR, AND THE PROGRAM WAS SCHEDULED FOR COMPLETION BY 1964. THIS ARTICLE WAS PUBLISHED IN "THE SCIENCE TEACHER," VOLUME 30, NUMBER 6, OCTOBER 1963. (NH)

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Teaching Science to the Disadvantaged Pupil

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THE Biological Sciences Curriculum Study is investigating the feasibility of tailoring a program in biology to fit the needs and abilities of the one-half million slower learners in the biology classes of the nation's high schools. The study finds that it is impossible to separate the socioeconomic factors from the task it is attempting. An estimated 30-50 percent of these pupils seem to be culturally deprived, disadvantaged Americans. What the BSCS ought to do and can do for these youngsters, whose reading levels range upward from the second grade and whose desires to be taught span from the highly desiring to the stubbornly resistive, remains a question. That they have worth as becoming productive citizens sharing the responsibilities of a democratic society is not doubted. That they need and can learn the minimal science basic to being informed citizens is the consensus of the many who have contributed ideas and suggestions to the BSCS Special Student Project, the first of the major national movements involved with science curriculum revision to become involved with the limited learner and, consequently, with the socioeconomic background of its students.

To be disadantaged is a relative matter. If the most disadvantaged student in our American high school were transplanted to many other groups elsewhere in the world, he would be recognized as a very advantaged person, literate and intelligent. He would be able to read and write, add and subtract, and relate a great deal about the so-called civilized world. But in America he is a limited learner, a disaffected youth, a disadvantaged American; he is culturally deprived.

The relativeness in the situation, of course, is due to the present social, economic, and educational status of the large majority of people in America. The median school years completed by adults 25 years old and older in seven states is now beyond the twelfth grade; in three-fourths of the states it is beyond the tenth (6). The large middle class for the past two and one-half decades has placed a premium on education and on becoming skilled. Our technological society has rapidly become more and more technological, consuming in fantastic numbers skilled professional and semiprofessional men and women. There is hardly a place anymore for the unskilled: The machines have taken over the pick and shovel, even the human hand in such skillful "unskilled" labor as cotton harvesting. A distinguishing mark of the disadvantaged is that he does not have the advantage of being skilled in doing something that fits somewhere into the technological pattern of our society.

Who Are the Disadvantaged?

A half-dozen books have been written during the past three years on the subject of the disadvantaged American and the culturally deprived. Recent issues of periodicals have been dedicated to this cause (2). The writers, most of whom are specialists in the field of educational sociology, educational psychology, and psychiatry, seem to agree that our disadvantaged citizens are victims of their environment and have a very limited perspective and understanding of the society of which they are a part. They have limited aspirations, not commensurate with their latent abilities. By being deprived, they are further deprived in school with what usually amounts to a second-rate education even in a first-rate school system. They are not understood by their middle-class teachers. They want to learn, but resist the methods of the ordinary educational system to get them to learn. They are not interested in special favors, but do want, like all human beings, to be respected (2, 7, 8, 9). They lag in school achievement and do not read at or near their grade level (5, 7, 8). It is estimated that nearly one-half of the slow learners—the low 20-30 percent on the academic scale—in our secondary schools come from the ranks of the culturally deprived, a group which harbors far more potential in ability and aptitude than does the advantaged slow learner group.

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The disadvantaged pupils' appearance in our large city schools is increasing at a tremendous rate. The Educational Policies Commission predicts that by 1970, if present trends are not reversed, one-half of our large cities will be inhabited by the disadvantaged Americans (5, p. 10). This would mean that at least one-half of the enrollment in the schools would consist of students from disadvantaged homes. This trend has alarmed a number of spokesmen to the point that the culturally deprived are now in the spotlight. Our large cities have received grants and have budgeted local monies to investigate the problem of the disadvantaged. There are the Great Cities Project, New York's Higher Horizons, Cleveland's Hough Community Project, Philadelphia's School Improvement Project, to name a few (3, pp. 17-20).

It is interesting to note that the ranks of the culturally deprived nation-wide have not increased; they only seem to be increasing because, heretofore, they have been isolated in remote rural areas, unnoticed. Now that they are migrating to the cities for a better life, they have become conspicuous.

Even though the school dropout rate for this group is high, large numbers of disadvantaged pupils survive their educational experience into and through high school. Compulsory attendance laws encourage many to remain through the ninth and tenth grade. Many pupils stick with it and graduate, because they have learned from experience that it is much easier to get a job with a high school diploma than without one. The general tendency to remain in school is reflected in the fact that the enrollments in some of our large city high schools are composed almost entirely of disadvantaged Americans.

Science Offerings

Of course, these youngsters take science, and they are enrolled in large numbers in the science classes. If you visited the schools in our large cities, you would find most of them in the "general" classes: general science in the ninth grade and general biology in the tenth. You would find that the science program in which these "generals" find themselves is, in the main, entirely lacking in laboratory work and teacher demonstration. High school buildings in the large cities are usually old and were designed back in the days when one biology laboratory for a high school of 2,000-3,000 students was considered sufficient. Today, in more schools than not, one and only one laboratory remains and is used continuously and exclusively for the honors and college prep classes.

The situation is generally deplored and regretted. One science supervisor in a large city school system remarked that the generals are given a lecture-reading type course, and the higher achievers get an activity program; whereas, perhaps, it should be the other way around. The less able, the less articulate, the less verbal, need the activity in the lab to help them learn. The more able, with a greater power to abstract, are much more at home with textual materials and class discussion than are the less able; but of course, they, too, need the experiences in scientific inquiry provided by the laboratory.

Serious effort is being made in most large city school systems to provide laboratory facilities for all classes in the science program. But the outlook is discouraging. The tax rate in some of our large cities has reached the statute limitation while property within the school district has devaluated. To add three or four laboratories to each of, say, 50 high schools requires finances which seem under the present circumstances not to be available.

Teacher and Pupil

Associated with the effort and the need to provide laboratory facilities for the less able and the disadvantaged, there seems to be a serious sociological problem involving the pupil and the teacher, a problem which, as yet, has not been recognized or clarified in the literature. In visiting schools during the 1963-64 academic year, a correlation seems to have been observed between the quality of the science program and the socioeconomic background of the school community, other factors being equal. In large city school systems, for example, where the minimum teacher preparation and available monies were the same throughout all the high schools in the system, it was observed that the more deprived the school community, the lesser the quality of the science program.

To illustrate this relationship of economic deprivation and quality of the science program, may I describe my observations in one large city school system. In this district, laboratory facilities are available to all science classes. All the school plants are kept in tip-top shape. To teach in this system, a candidate must pass a qualifying examination and have an accumulation of semester hours of credits in his major field beyond the minimum to meet state certification requirements. Teachers throughout the system are on the same salary schedule. School A is located in an area that is comprised of the so-called culturally deprived, disadvantaged Americans. School officials reported that 10-30 percent of the students enrolled are absent each day. About one-half of the students who enter in September are not the same one-half who finish in June. Average reading level in the school is seventh grade and the average IQ as measured by verbal tests is 85. In visiting the biology classes, we found the rooms (lab-classroom combinations) to be barren. The class activity consisted mainly of students' taking turns reading from the text, with the teacher interspersing the procedure with comment. As we moved to schools B, C, D, and E, we progressively moved to schools having higher and higher socioeconomic backgrounds. We observed that the quality of the science program improved from school to school. In school D, a biology teacher and his students were working on a research project supported by the National Institutes of Health. The biology lab-classrooms were alive with "biology." In school E, located in a well-to-do upper middle class and lower upper class community, science was being taught as so many these days say it should be taught. The study of biology was being approached through biology as a science. The students were discovering for themselves important concepts through an investigative approach afforded by the laboratory. The biology lab-classroom was a research lab, with student projects located wherever space permitted.

The most significant part of this narrative now follows: In school E, teacher Mr. Doe was asked how he would react to the proposal that he be transferred to school A, over in the deprived part of town, to set up a science program such as he had in school E, with the understanding that at the end of two years he would then return to his present school. The teacher thought a few

seconds and replied, "If the administration insisted that I do this, I would resign." "Why?" "When I teach I must as a teacher and as a human being be stimulated by my students through feedback from them. I put a lot into my teaching; here these youngsters are bright and highly motivated. They find science exciting and are responsive. I have taught students like those in School A. I am fully sympathetic with them. But I cannot get the response from them that I must have to find satisfaction in teaching. These youngsters are unresponsive, to me at least, and unmotivated. Most of them don't care whether school keeps or not."

The correlation between the socio-economic background and the quality of the science program seems to exist quite generally over the country. I have often pondered the causes, especially in those cities which provide well-trained teachers and equal financial resources to all. I believe the situation is a fertile field for research. I am inclined to believe that perhaps Mr. Doe provided the answer. It might well be that when a good teacher, full of good intentions, goes the second mile in providing a first-rate science program for these youngsters, he may eventually give up in despair because these youngsters may seem to be unresponsive, unappreciative, unproductive, thus providing no reinforcement for the teacher.

Science for the Disadvantaged

But, the disadvantaged pupil needs to have a first-rate program in science and other basic subjects, and he needs, perhaps more than anyone else, first-rate teachers, and first-rate teaching, for several reasons.

1. He represents a significant segment of our society—a segment that is important and could be more important as a contributor of worthwhile service to society; he is important as a potential voter and important for the fact he is a human being who shares with others the responsibilities of a democratic society.
2. As a human resource this group in our classrooms across the nation is a gold mine of hidden talent. For example, the Cook County Department of Public Aid recently completed a study of 646 dependent youngsters age 16 through 20 who had dropped out of school. The reading levels ranged from grade 2.6 to grade 10, with 40 percent measuring below grade 6. Yet on the Beta nonverbal intelligence test, over one-half of these youngsters had IQ's ranging from 90 to 123 (3, p. 30; 7, chapter 6).

That these youngsters have a great potential in our technological society apparently is not doubted by those who have studied the problems of the disadvantaged. These youngsters deserve good teaching, and they need good teachers, teachers who will tolerate them and respect them, even though they may come from a different class, a different cult than they. Needed are teachers who understand that these youngsters have different values and different aspirations than they, and that these pupils come from a group that often has different family structuring than their own.

A teacher also needs a strong subject-matter background, especially on the secondary level, and herein lies one of the great weaknesses in our attempts to provide a suitable and meaningful education for these pupils. These pupils are often placed into a program wherein the newest, the youngest, the most inexperienced teacher is assigned to teach them. An experienced teacher, an understanding teacher is needed (5, pp. 19, 20). Too often, teachers who have less than a minor in the subject are assigned to teach these classes. If these youngsters are going to be given a valuable and meaningful program in science, they need a teacher who understands science, a teacher who has a good subject-matter background in science and who understands how to teach science to the disadvantaged.

There are a few teachers who do find teaching these pupils rewarding. If somewhere in the professional training of teachers, prospective teachers become aware of this group and the associated educational and sociological problems, more and more teachers would choose to teach these pupils; and many others would do a better job of teaching them. Every methods course should include an hour or two wherein the teacher in training is given opportunity to explore this problem.

In teaching science to the disadvantaged, it is important to help them acquire an understanding of the importance of science in today's world, how it has contributed to our standard of living and to the culture of modern society. These youngsters also need to know how the scientist goes about his work. They also need to gain appreciations for science. To learn these various aspects of science, the disadvantaged as well as other students need to do some actual "sciencing."

In regard to the question of what is the best subject matter for the group, there are two schools of thought: One school is represented by influential voices saying that these youngsters, many of whom will not be going beyond the tenth grade, could best benefit from a program oriented to health and human physiology. They need to know how to take care of their bodies, to know the rudiments of nutrition and sanitary living, and to know how their body works, it is argued. The other school of thought would say that these youngsters have had enough of this type of instruction by the time they reach the tenth grade. They should now be given the opportunity to become familiar with the important basic concepts in science and to be introduced to the processes of science. They are ready and require something new. It is now time to familiarize them with the basic scientific principles regarding the world and universe surrounding them and of which they are a part. That these youngsters can grasp these concepts is a proposition supported by a number of current spokesmen. Jerome Bruner's notion that any concept can be taught at any level now seems to be commonly accepted (1, pp. 33, 43, 46, 47). Hubert Evans of Columbia University offers additional hope that our disadvantaged pupils can become sufficiently literate in science when he says,

> Scientific literacy does not require a survey and understanding of the whole of science and technology. A relatively small number of fundamental scientific concepts and conceptual schemes can be identified and, when understood, can form a firm foundation for understanding the nature of the sciences and scientific work and for interpreting the newer developments as they come along. (3, p. 33).

George W. Beadle, Nobel laureate and president of the University of Chicago, recently wrote,

> As scientific knowledge grows, it tends to become simpler in one important respect: As the facts increase, the principles often become fewer, clearer, and easier to understand. (3, p. 34).

The advocates of the second school of thought would say that these rela-

tively few basic scientific concepts would and should be the ones given emphasis in a program for these pupils, and in the study of these concepts these pupils can learn best through a discovery approach as offered through laboratory investigations.

Program Expectations

The Biological Sciences Curriculum Study is attempting to prepare a program for the limited learner (low 30 percent in our academic classes) which consists of a large number of disadvantaged pupils. It is currently working on the premise that these youngsters need and deserve a program which explores important, basic concepts in modern biology. The consensus of biology teachers generally, especially those who have taught the BSCS biology, supports the BSCS premise. The BSCS holds to the conviction that these youngsters will find more interesting adventures in their school experience in science through traveling new roads related to updated concepts in biology than retraveling the byways of health, disease, and nutrition.

During the summer of 1963, three experimental units were prepared, based on this premise. These units explore important ideas in genetics, ecology, and cellular biology. They will be tried by about 1,000 students during the 1963-64 school year. The construction of a complete year's program is scheduled for the summer of 1964. It is hoped that through the materials prepared and the program developed and the quality of teaching provided, these youngsters will find the course fascinating and challenging and will want to come back to class day after day. If this can be accomplished, perhaps this program will contribute to the effort to keep these youngsters in school and to provide a program which they appreciate.

In developing the program, the BSCS is cognizant of the associated sociological problems—those that relate to the pupil and his cultural background and to the pupil and his teacher.

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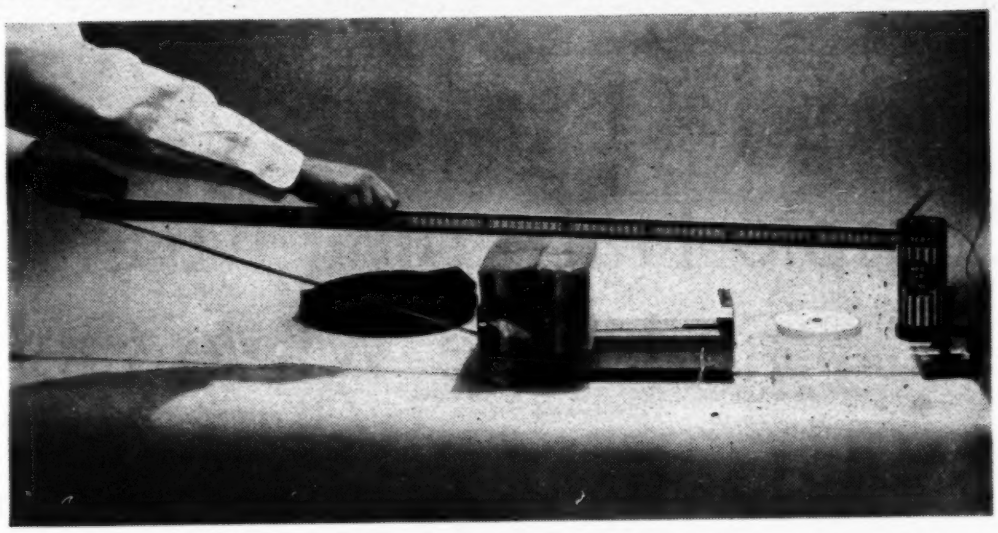

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